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PN - JP2000046578 A 20000218
TI - APPARATUS FOR MEASURING WALKING STEP
FI - G01C22/00&W
PA - MATSUSHITA ELECTRIC IND CO LTD
IN - AMANO TOMOYASU; KACHI TOSHIHIKO; KIDA JUNICHI; TAKAHASHI YOSHIO
AP - JP19980216188 19980730
PR - JP19980216188 19980730
DT - I

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AN - 2000-227799 [20]
TI - Walk distance measuring apparatus in aged person monitoring system, measures phase difference between transmitted and received soundwave to detect distance walked by aged person
AB - JP2000046578 NOVELTY - The transmitter (11) and receiver (31) that transmits and receives sound waves are attached to the right and left ankle of aged people. The receiver receives the sound wave transmitted from the transmitter. The receiver then measures the distance between the transmitter and receiver by measuring the phase difference between the transmitted wave and received sound wave.
- USE - Used for measuring distance walked by aged people, in aged person wandering monitoring system.
- ADVANTAGE - Measures the present position without using the global positioning satellite information and without using special sensor. DESCRIPTION OF DRAWING(S) - The figure shows the walk distance measuring apparatus during the walking condition. (11) Transmitter; (31) Receiver.
- (Dwg.6/12)
IW - WALKING DISTANCE MEASURE APPARATUS AGE PERSON MONITOR SYSTEM MEASURE PHASE DIFFER TRANSMIT RECEIVE DETECT DISTANCE WALKING AGE PERSON
PN - JP2000046578 A 20000218 DW200020 G01C22/00 007pp
IC - G01C22/00
MC - S02-B12
DC - S02
PA - (MATU) MATSUSHITA DENKI SANGYO KK
AP - JP19980216188 19980730
PR - JP19980216188 19980730

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PN - JP2000046578 A 20000218
TI - APPARATUS FOR MEASURING WALKING STEP
AB - PROBLEM TO BE SOLVED: To measure the distance between a transmitter and receiver by measuring the phase difference between sound waves transmitted from sonic wave transmitters mounted on the right and left ankles of a human body and sound waves received by a separately provided receiver.
- SOLUTION: A connector for connecting a transmitter 11 and receiver is provided on the side face of the transmitter 11 at the tiptoe side. CPU and clock are provided in the transmitter 11 in addition to a transmitter part 14 and mounted on a magic tape 13, etc., thereby making them conveniently mountable on the ankle of left foot 15 (and right foot). The transmitter 11 transmits e.g. a transmission sound wave of about 100 Hz, a receiver computes the relative distance between the transmitter 11 and receiver from the phase delay of the received sound wave from the transmitted sound wave. This work is repeated every forward step of the right and left feet to discriminate the stepping direction, a fine change of the walking distance in the moving direction is compensated to enable the walking distance measurement at a high accuracy. Thus the walking distance and direction of a carrier can be accurately measured from the measurement of the step and discrimination of the stepping direction.
I - G01C22/00
PA - MATSUSHITA ELECTRIC IND CO LTD
IN - KACHI TOSHIHIKO;TAKAHASHI YOSHIO;KIDA JUNICHI;AMANO TOMOYASU
ABD - 20000914
ABV - 200005
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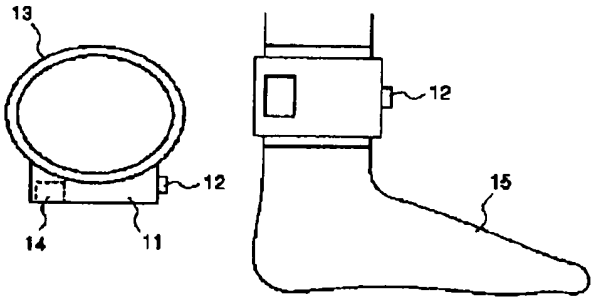
APPLICANT : MATSUSHITA ELECTRIC IND CO LTD;

INVENTOR : AMANO TOMOYASU;

INT.CL. : G01C 22/00

TITLE : APPARATUS FOR MEASURING WALKING STEP



ABSTRACT : PROBLEM TO BE SOLVED: To measure the distance between a transmitter and receiver by measuring the phase difference between sound waves transmitted from sonic wave transmitters mounted on the right and left ankles of a human body and sound waves received by a separately provided receiver.

SOLUTION: A connector for connecting a transmitter 11 and receiver is provided on the side face of the transmitter 11 at the tiptoe side. CPU and clock are provided in the transmitter 11 in addition to a transmitter part 14 and mounted on a magic tape 13, etc., thereby making them conveniently mountable on the ankle of left foot 15 (and right foot). The transmitter 11 transmits e.g. a transmission sound wave of about 100 Hz, a receiver computes the relative distance between the transmitter 11 and receiver from the phase delay of the received sound wave from the transmitted sound wave. This work is repeated every forward step of the right and left feet to discriminate the stepping direction, a fine change of the walking distance in the moving direction is compensated to enable the walking distance measurement at a high accuracy. Thus the walking distance and direction of a carrier can be accurately measured from the measurement of the step and discrimination of the stepping direction.

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審査請求　未請求　請求項の数６　ＯＬ　（全７頁）

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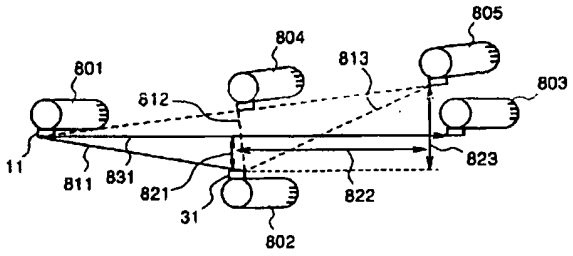
最終頁に続く

(54)【発明の名称】　歩幅測定装置

(57)【要約】
【課題】　ＧＰＳを用いた徘徊老人探査器では、ＧＰＳによる位置情報がアーケード、街路樹、ビル等により遮られて入手できなくなることがあるのが問題である。そこでＧＰＳ情報を用いずに現在位置を測定する装置を提供する。
【解決手段】　人体の左右の足首に送信機１１と受信機３１を取り付け、１００Hz程度の音波を送受信し、送信した音波と受信した音波の位相差により歩幅を測定する。さらに歩行距離に補正をかけることにより、精度の高い位置情報を提供することができる。



【特許請求の範囲】
【請求項１】　音波を用いる歩幅測定装置において、人体の左右の足首に装着され、音波を送信する送信機と、
上記送信機から送信した音波を受信し、上記送信した音波と該受信した音波との位相差を測定し、上記送信機と該受信機との間の距離を測定する受信機とを備えたことを特徴とする歩幅測定装置。
【請求項２】　請求項１記載の歩幅測定装置において、上記送信機及び上記受信機は、それぞれ時計を内蔵し、該送信機と該受信機は、相互に接続して双方に内蔵した上記時計の時刻合わせを行うことが可能であることを特徴とする歩幅測定装置。
【請求項３】　請求項１記載の歩幅測定装置において、上記受信機は、上記送信機と該受信機との間の距離の変化より、足の着地を判別するものであることを特徴とする歩幅測定装置。
【請求項４】　請求項１記載の歩幅測定装置において、上記受信機は、上記送信機と該受信機との間の距離の変化より、足の踏み出し方向を判別するものであることを特徴とする歩幅測定装置。
【請求項５】　請求項１記載の歩幅測定装置において、上記送信機、及び上記受信機の足首への取付状態における、上記送信機に内蔵された送信部、及び上記受信機に内蔵された受信部の位置は、一方が足首の前方寄りで、他方が足首の後方寄りであり、
上記受信機は、上記送信部と上記受信部との間の距離の所定歩数以上の変化から上記送信機、及び該受信機のいずれを左足の足首に装着し、いずれを右足の足首に装着したかを判別することができることを特徴とする歩幅測定装置。
【請求項６】　請求項１ないし５のいずれかに記載の歩幅測定装置において、
上記受信機は、ＧＰＳ受信機、ＰＨＳ等の通信装置、及び地磁気センサを装着したことを特徴とする歩幅測定装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、歩幅測定方法及び装置に関し、特に歩行距離、及び歩行方向を正確に検出できる方法及び装置に関するものである。
【０００２】
【従来の技術】近年人口に占める高齢者の比率が高まるにつれて、老人介護についての問題が数多く発生している。この内、痴呆老人の徘徊問題については徘徊を防止、もしくは老人を速やかに保護する方法及び装置が数多く提案されているが、中でもＧＰＳにより得た位置情報をＰＨＳ等の通信機器によって送信する徘徊老人探査器が注目されている。
【０００３】前記徘徊老人探査器は老人にＧＰＳ回路とＰＨＳ等の通信機器により構成された携帯端末を装着させ、家庭内に配置した基地局から必要なときに送信要求を出せば、現在の老人の位置が前記携帯端末から送信されて、基地局側の地図上に表示されるというシステムであり、多くの企業、地方自治体により検討がなされている。
【０００４】
【発明が解決しようとする課題】しかし、ＧＰＳによる位置情報の入手には下記のような問題点がある。
（１）アーケード、地下街、街路樹の多い歩道等の空が見えないような場所では、　衛星の電波が到達しないために位置情報が入手できない。
【０００５】（２）市街地等、ビルが数多く立地したような所では、ビルに反射した電波が干渉するために、正確な位置情報を得られない場合がある。
【０００６】（３）位置情報に意図的に誤差成分が挿入されているために、十分な精度が得られない場合がある。
【０００７】これらの問題点を補うためには、人体に何らかのセンサを取り付け、これにより歩行距離を測定して位置情報を補正する必要がある。現在普及が進んでいるカーナビゲーションシステムでは、自動車に取り付けた加速度センサや振動ジャイロを用いた、いわゆる自立航法による補正が発達しているが、人間の歩行においても加速度センサによる計測が提案されている（特開平９－１５２３５５号公報）。またその他の方法として、振動センサもしくは感圧センサを用いて歩行時の歩数を計測して、あらかじめ計測しておいた歩幅と乗算することにより歩行距離を求める方法が提案されている（特許登録第２５５２１３５号、他）。
【０００８】ところが、上記の加速度センサによる計測では、人間の歩行は自動車と比較して速度が遅いために加速度の変化が微量であり、検出が難しいために精度の高い正確な計測が困難であり、また上記の振動センサによる歩数と歩幅による計測では、あらかじめ歩幅が一定でまっすぐに歩くという条件が必要であり、一般の成人に比較して歩行がおぼつかない老人では歩幅のばらつきや蛇行が起こるために、距離が増すに従って誤差が拡大するという問題点があった。
【０００９】本発明では、以上のような問題点を解消するためになされたもので、ＧＰＳによる位置情報を用いずに、精度の高い現在位置を測定することのできる歩幅測定装置を提供することを目的とする。
【００１０】
【問題を解決するための手段】本発明の請求項１に係る歩幅測定装置は、人体の左右の足首に装着し、音波を送信する送信機と、上記送信機から送信した音波を受信し、上記送信した音波と該受信した音波との位相差を測定し、上記送信機と該受信機との間の距離を測定する受信機とを備えたものである。

【００１１】本発明の請求項２は、上記請求項１記載の歩幅測定装置において、上記送信機及び上記受信機に、それぞれ時計を内蔵させ、該送信機と該受信機を、相互に接続して双方に内蔵した上記時計の時刻合わせを行うことを可能とするものである。

【００１２】本発明の請求項３は、上記請求項１記載の歩幅測定装置において、上記受信機が、上記送信機と該受信機との間の距離の変化より、足の着地を判別するものである。

【００１３】本発明の請求項４は、上記請求項１記載の歩幅測定装置において、上記受信機が、上記送信機と該受信機との間の距離の変化より、足の踏み出し方向を判別するものである。

【００１４】本発明の請求項５は、上記請求項１記載の歩幅測定装置において、上記送信機、及び上記受信機の足首への取付状態における、上記送信機に内蔵された送信部、及び上記受信機に内蔵された受信部の位置が、一方が足首の前方寄りであり、他方が足首の後方寄りであることにより、上記受信機が、上記送信部と上記受信部との間の距離の所定歩数以上の変化から、上記送信機、及び該受信機のいずれを左足の足首に装着し、いずれを右足の足首に装着したかを判別するものである。

【００１５】本発明の請求項６は、上記請求項１ないし５のいずれかに記載の歩幅測定装置において、上記受信機に、ＧＰＳ受信機、ＰＨＳ等の通信装置、及び地磁気センサを装着したものである。

【００１６】

【発明の実施の形態】以下、本発明の実施の形態による歩幅測定装置について、図を参照しつつ説明する。

【００１７】実施の形態１．図１～図４は、本実施の形態１による歩幅測定装置の構成を説明するための図であり、図５～図９は、この歩幅測定装置の動作を説明するための図である。

【００１８】図１は本発明の実施の形態１による歩幅測定装置の送信機の形状、及び左足への取付状態を示す図である。１１は、内部の足の踵寄りに送信部１４が組み込まれている送信機である。前記送信機１１の爪先側の側面には、該送信機１１と図３における受信機３１とを接続するための接続コネクタ１２が設けられている。前記送信機１１は、マジックテープ等１３に取り付けられており、左足１５の足首に簡便に装着できるようになっている。また図２は、前記送信機１１の内部ブロック図であり、該送信機１１の内部には前記送信部１４の他に、ＣＰＵ２１、及び時計２２が組み込まれている。

【００１９】次に図３は本発明の実施の形態による歩幅測定装置の受信機の形状、及び右足への取付状態を示す図である。前記受信機３１の内部には、足の爪先寄りに受信部３４が組み込まれている。前記受信機３１の踵側の側面には、該受信機３１と前記送信機１１とを接続するための接続コネクタ３２が設けられている。前記受信機３１は、マジックテープ等３３に取り付けられており、右足３５の足首に簡便に装着できるようになっている。また図４は、前記受信機３１の内部ブロック図であり、該受信機３１の内部には前記受信部３４の他に、ＣＰＵ４１、時計４２、及び位相検出部４３が組み込まれている。

【００２０】また、前記送信機１１は、前記接続コネクタ１２に該送信機１１の時刻を常時出力しており、前記受信機３１は、前記接続コネクタ１２と前記接続コネクタ３２の接続により該送信機１１の時刻が得られるようになると、自動的に該受信機３１の時刻を該送信機１１の時刻に合わせるという機能を備える。

【００２１】次に動作について説明する。図５は前記送信機１１から１００Ｈｚの音波を送信した場合の、前記送信機１１から送信した音波と、前記受信機３１により受信した音波の関係を示す図である。前記送信機１１は１００Ｈｚの送信音波５１を送信し、前記受信機３１は受信した受信音波５２の前記送信音波５１との位相の遅れ５３により、前記送信機１１と該受信機３１との相対距離を計算する。また１００Ｈｚの音波は１０ｍｓが１周期であり、前記受信機３１は１０ｍｓ間隔で送信音波との位相を比較する。

【００２２】次に図６は前記送信機１１と前記受信機３１とを足首に装着して歩行したときの状態を示す図である。ここで６１は左足を、６２は右足をそれぞれ示し、６３は右足を踏み出したときの送受信機間の距離を、６４は左足を踏み出したときの送受信機間の距離をそれぞれ示している。

【００２３】図７は図６の状態における前記送信機１１と前記受信機３１との間の距離の変化をグラフ化した図である。ピーク７１を、左足を前に踏み出したときとすれば、ディップ７２は右足が踏み出す途中で左足の横に来たときであり、ピーク７３は右足を前に踏み出したときである。従って前記送信機１１と前記受信機３１との距離を連続的に測定していけば、ピーク時の距離を歩幅と見なすことができる。

【００２４】次に図８は、上記歩幅測定装置を装着しての歩行状態における、足の踏み出し方向の変化による進行方向に対する歩行距離の変化の補正方法を示す図である。８０１，８０３，８０４，８０５は、前記送信機１１を足首に装着した左足であり、８０２は前記受信機３１を足首に装着した右足である。図において、測定を開始する直前の前記左足８０１から、最初の１歩目の前記右足８０２を踏み出したときに、前記左足８０１と前記右足８０２との間隔８２１を固定値１５ｃｍと見なし、基準座標８３１を決定する。この作業は測定開始時に１度行うだけであり、前記基準座標８３１はあくまでも両足の移動場所を座標上で表現するために必要なものであり、その後の進行方向と一致する必要はない。従って前記両足の間隔８２１は任意の値でかまわない。ここでは

通常の平均的な両足の間隔として１５ｃｍに設定している。次に、左足８０５は、これまでの進行方向と同じ向きに足を踏み出した場合の左足８０３に対して微妙に角度を持って踏み出した状態であり、前記左足８０１から前記左足８０５まで移動している時間の中間点にある左足８０４での前記右足８０２からの距離８１２を測定しておく。この距離８１２と、前記左足８０５と前記右足８０２との距離８１３と、前記左足８０１と前記右足８０２との距離Ｓ１１の３つのパラメータに余弦定理をあてはめ、前記右足８０２から前記左足８０５への距離を、前記基準座標８３１に対して平行移動距離８２２と垂直移動距離８２３に分解して算出する。

【００２５】以降、足を踏み出す毎に上記の作業を繰り返すことにより、踏み出し方向を判別し、進行方向に対する歩行距離の微妙な変化を補正する事ができ、精度の良い歩行距離の測定をすることができる。

【００２６】次に図９は前記送信機１１と前記受信機３１との距離の変化をグラフ化した図である。本実施の形態１では前記送信部１４が左足首の前方寄りで、前記受信部３４が右足首の後方寄りに取り付けられているので、前記送信部１４、及び前記受信部３４を足首の中心に取り付けた場合の相対距離の変化９１に対して、歩行時に左足を前に踏み出したときの両足の相対距離９２が長くなり、右足を前に踏み出したときの両足の相対距離９３が短くなる。この相対距離の差を歩行データから検出して、左右の足を判別する。これにより、図８で示した歩行距離の微妙な変化が、左右どちらの足で発生しているのかを認識することができる。

【００２７】このように本実施の形態１によれば、歩幅測定装置の装着者の歩行距離、及び歩行方向を、歩幅の測定、及び踏み出し方向の判別によって正確に計測することにより、精度の高い正確な現在位置を得ることができる。

【００２８】なお、上記実施の形態１では、内部の足の踵寄りに送信部が組み込まれた送信機を左足に、内部の足の爪先寄りに受信部が組み込まれた受信機を右足にそれぞれ取り付けたが、これは送信機を右足に、受信機を左足にそれぞれ取り付けたものとしてもよく、あるいは、送信機の内部の足の爪先寄りに送信部を組み込み、受信機の内部の足の踵寄りに受信部を組み込んだものとしてもよい。

【００２９】実施の形態２．図１０は、上記実施の形態１による歩幅測定装置の受信機にＧＰＳ、及びＰＨＳ、及び地磁気センサを装着した本発明の実施の形態２における徘徊老人探査器を示す図であり、図１１は、上記受信機の内部ブロック図である。

【００３０】図１０及び図１１において、１０５は内部にＧＰＳアンテナ１０１、及びＧＰＳユニット１１３、及び地磁気センサ１０３が組み込まれている受信機であり、外部のＰＨＳ１０４とは外部ケーブル１０２を介して接続されている。また、前記受信機１０５のその他の構成については実施の形態１のものと同様に、受信部１０６，接続コネクタ１０７，ＣＰＵ１１１，位相検出部１１２，時計１１４をそれぞれ備える。なお送信機の構成については、実施の形態１のものと同様である。

【００３１】上記徘徊老人探査器は、前記受信機１０５に装着した前記ＧＰＳアンテナ１０１から前記ＧＰＳユニット１１３を通した位置情報を前記ＣＰＵ１１１が入手し、前記外部ケーブル１０２を介して前記ＰＨＳ１０４より家庭内の基地局に一定時間間隔で自動的に送信するシステムである。あるいは家庭局側からの呼び出しに応じて位置情報を送信するシステムであっても良い。

【００３２】次に動作について説明する。まず、老人が上記徘徊老人探査器を装着した状態で住宅から外出すると、ＧＰＳによる位置情報が入手される。住宅の緯度経度は既知の値であるから、あらかじめ住宅の位置を基準として入力しておくことにより、初期のＧＰＳによる位置情報の誤差成分をキャンセルすることができる。前記歩幅測定装置は、前記地磁気センサ１０３から方位を入手し、歩行方向を判別して歩幅による移動距離測定を開始する。ＧＰＳによる位置情報と前記歩幅測定装置による位置情報が徐々にずれていくような状態では、前記歩幅測定装置による位置情報が間違っていると判断して、歩幅に一定の数値を乗ずることにより補正を行う。この補正を一定間隔で行うことにより、歩幅測定の精度を向上させる。

【００３３】一方、通常はＧＰＳによる位置情報を使用するが、ＧＰＳによる位置情報と前記歩幅測定装置による位置情報が大きく異なる場合には、ＧＰＳによる位置情報の誤差成分が増大したと判断して、前記歩幅測定装置による位置情報を用いるようにする。外出途中でアーケード、あるいは街路樹の多い場所等にさしかかり、ＧＰＳによる位置情報が得られない状態になった場合は、前記歩幅測定装置による位置情報と、前記地磁気センサ１０３による方位情報により現在位置測定を行う。

【００３４】図１２はアーケード内で上記徘徊老人探査器を携帯した老人が歩くのを止めて立ち止まり、次に元の道を引き返し始めた状態を示す図である。アーケード内のためＧＰＳ信号は得られないので、歩幅測定の波形１２１と前記地磁気センサ１０３の示す方位１２２により老人の行動を測定する。

【００３５】今、老人が北の方角に歩いている状態を１２３とすると前記地磁気センサの示す方位１２２は北を指し示す。そして、１２４の状態では、歩幅測定の波形１２１が変動しなくなったことにより老人が立ち止まったことが認識される。続いて１２５の状態では、前記地磁気センサの示す方位１２２が方向の変化を捕らえ、老人が逆の方向を向いたことが認識される。さらに１２６の状態では、前記歩幅測定の波形１２１が変動を始め、老人が再び歩き出したことが認識される。

【００３６】また、さらなる悪条件として、住宅の玄関がアーケード内にあって出発地点からＧＰＳによる位置情報が得られないような場合であっても、あらかじめ住宅の位置を基準として入力しておけば、そこからの移動距離として現在位置を測定できる。

【００３７】このように本実施の形態２によるＧＰＳを用いた徘徊老人探査器では、上記実施の形態１の効果において、歩幅測定装置の装着者の歩行距離、及び歩行方向を、歩幅の測定、及び踏み出し方向の判別によって正確に計測することにより、精度の高い正確な現在位置を得ることができたのに加え、ＧＰＳを用いたことにより、さらに、より高い精度で正確な現在位置を得ることができる。

【００３８】なお、本実施の形態２では、位置情報を送信するのにＰＨＳを用いたが、これは、その他の通信手段を用いたものとしてもよい

【００３９】

【発明の効果】以上のように本発明の請求項１に係る歩幅測定装置によれば、人体の左右の足首に装着され、音波を送信する送信機と、上記送信機から送信した音波を受信し、上記送信した音波と該受信した音波との位相差を測定し、上記送信機と該受信機との間の距離を測定する受信機とを備えたので、上記測定した距離により、歩幅を計算することができるという効果がある。

【００４０】本発明の請求項２によれば、請求項１の歩幅測定装置において、上記送信機及び上記受信機は、それぞれ時計を内蔵し、該送信機と該受信機は、相互に接続して双方に内蔵した上記時計の時刻合わせを行うことが可能であるので、測定時において上記送信機と上記受信機の両者をケーブル等で接続する必要が無くなるという効果がある。

【００４１】本発明の請求項３によれば、請求項１の歩幅測定装置において、上記受信機は、上記送信機と該受信機との間の距離の変化より、足の着地を判別するものであるので、足の裏への感圧センサやフットスイッチ等を用いることなく足の着地を認識することができ、正確な歩幅測定を行うことができるという効果がある。

【００４２】本発明の請求項４によれば、請求項１の歩幅測定装置において、上記受信機は、上記送信機と該受信機との間の距離の変化より、足の踏み出し方向を判別するものであるので、歩行中の微妙な進行方向の変化を、特別なセンサを用いることなく認識できるという効果がある。

【００４３】本発明の請求項５によれば、請求項１の歩幅測定装置において、上記送信機、及び上記受信機の足首への取付状態における、上記送信機に内蔵された送信部及び上記受信機に内蔵された受信部の位置は、一方が足首の前方寄りで、他方が足首の後方寄りであり、上記受信機は、上記送信部と該受信部との間の距離の所定歩数以上の変化から、上記送信機、及び上記受信機のいずれを左足の足首に装着し、いずれを右足の足首に装着したかを判別することができるので、左右どちらに向かおうとしているかを、特別なセンサを用いることなく判別できるという効果がある。

【００４４】本発明の請求項６によれば、請求項１ないし５のいずれかに記載の歩幅測定装置において、上記受信機にＧＰＳ受信機、ＰＨＳ等の通信装置、及び地磁気センサを装着したので、アーケード内等でＧＰＳ信号が受信できなくなった場合でも、地磁気センサと歩幅測定による現在位置補正を行うことにより、正確に現在位置を検出することができるという効果がある。

【図面の簡単な説明】

【図１】本発明の実施の形態１における歩幅測定装置の送信機の外見図である。

【図２】上記歩幅測定装置の送信機の構成を示す内部ブロック図である。

【図３】上記歩幅測定装置の受信機の外見図である。

【図４】上記歩幅測定装置の受信機の構成を示す内部ブロック図である。

【図５】上記歩幅測定装置の送受信音波の位相比較図である。

【図６】上記歩幅測定装置を装着しての歩行状態を示す図である。

【図７】上記歩幅測定装置を装着しての歩行状態における送受信機間の相対距離を示す図である。

【図８】上記歩幅測定装置を装着しての歩行状態における、足の踏み出し方向の変化による進行方向に対する歩行距離の変化の補正方法を示す図である。

【図９】上記歩幅測定装置を装着しての歩行状態における左右の足の判別方法を示す図である。

【図１０】本発明の実施の形態２における、上記歩幅測定装置を備えた徘徊老人探査器を示す図である。

【図１１】上記歩幅測定装置を備えた徘徊老人探査器の受信機の構成を示す内部ブロック図である。

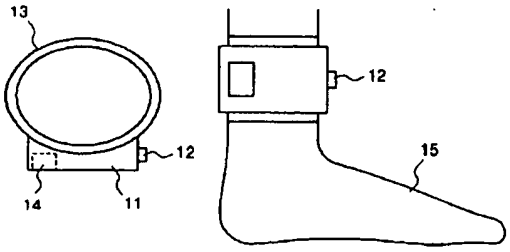
【図１２】アーケード内で徘徊老人探査器を携帯した老人が歩くのを止めて立ち止まり、次に元の道を引き返し始めた状態を示す図である。

【符号の説明】

１１　送信機
１２，３２，１０７　接続コネクタ
１３，３３　マジックテープ等
１４　送信部
１５　左足
２１，４１，１１１　ＣＰＵ
２２，４２，１１４　時計
３１　受信機
３４，１０６　受信部
３５　右足
４３，１１２　位相検出部
６１　左足

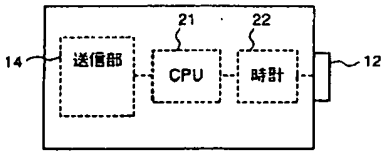
６２　右足
６３　右足を踏み出したときの送受信部間の距離
６４　左足を踏み出したときの送受信部間の距離
１０１　ＧＰＳアンテナ
１０２　外部ケーブル
１０３　地磁気センサ
１０４　ＰＨＳ
１０５　受信機
１１３　ＧＰＳユニット

【図１】

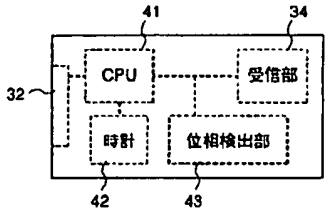


11：送信機
12：接続コネクタ
13：マジックテープ等
14：送信部
15：左足

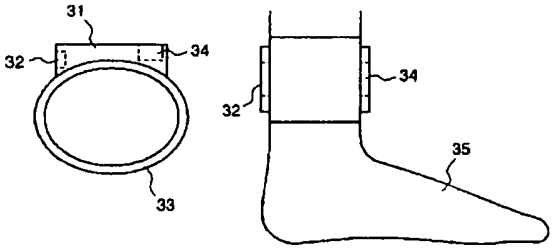
【図２】



【図４】

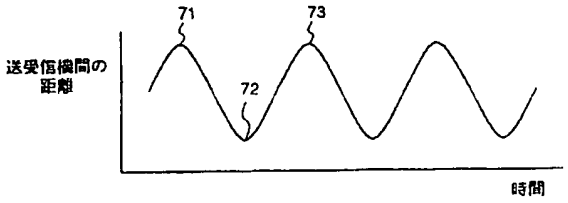


【図３】

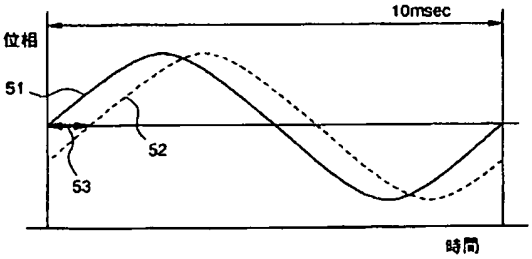


31：受信機
32：接続コネクタ
33：マジックテープ等
34：受信部
35：右足

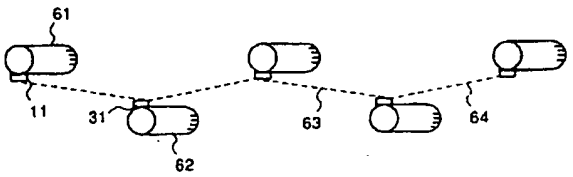
【図７】



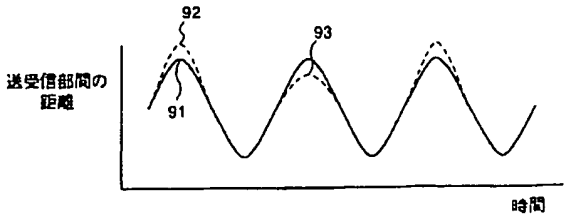
【図５】



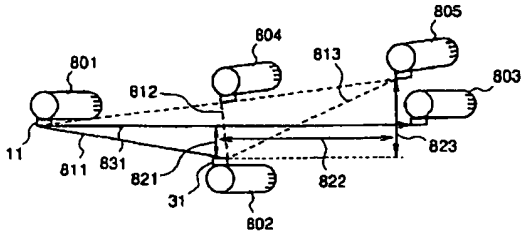
【図６】



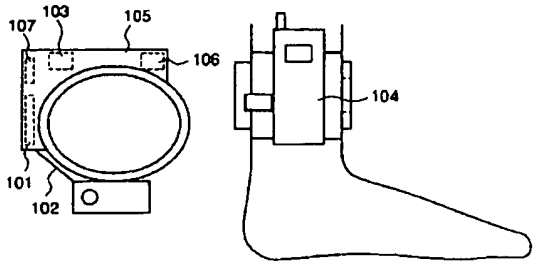
【図９】



【図8】

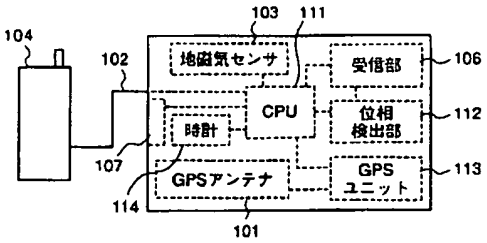


【図10】

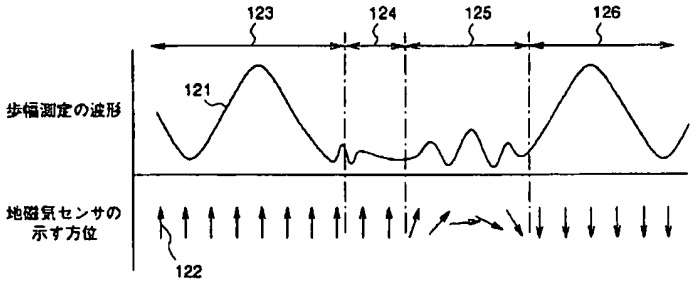


101：GPSアンテナ　105：受信機
102：外部ケーブル　106：受信部
103：地磁気センサ　107：接続コネクタ
104：PHS

【図11】



【図12】



フロントページの続き

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Fターム(参考)　2F024 BA01 BA09 BA10 BA15

JP2000046578

CLAIMS

[Claim(s)]

[Claim 1] The step measuring device which the ankle of right and left of the body is equipped with in the step measuring device using an acoustic wave, receives the transmitter which transmits an acoustic wave, and the acoustic wave transmitted from the above-mentioned transmitter, and is characterized by having the receiver which measures the phase contrast of the acoustic wave which carried out [above-mentioned] transmission, and the this received acoustic wave, and measures the distance between the above-mentioned transmitter and this receiver.

[Claim 2] It is the step measuring device which the above-mentioned transmitter and the above-mentioned receiver contain a clock in a step measuring device according to claim 1, respectively, and is characterized by it being possible to perform time-of-day doubling of the above-mentioned clock which connected this transmitter and this receiver mutually and was built in both sides.

[Claim 3] It is the step measuring device characterized by being that to which the above-mentioned receiver distinguishes landing of a guide peg from change of the distance between the above-mentioned transmitter and this receiver in a step measuring device according to claim 1.

[Claim 4] It is the step measuring device characterized by being what a guide peg steps toward the above-mentioned receiver from change of the distance between the above-mentioned transmitter and this receiver in a step measuring device according to claim 1, and distinguishes a direction.

[Claim 5] In a step measuring device according to claim 1, the location of the transmitting section built in the above-mentioned transmitter in the attachment condition to the ankle of the above-mentioned transmitter and the above-mentioned receiver, and the receive section built in the above-mentioned receiver One side is [another side] the back approach of an ankle in the front approach of an ankle. The above-mentioned receiver predetermined [of the distance between the above-mentioned transmitting section and the above-mentioned receive section] -- the number of steps -- the step measuring device characterized by the ability to distinguish with any the ankle of a left leg was equipped with any of the above-mentioned transmitter and this receiver from the above change, and the ankle of a right leg was equipped.

[Claim 6] It is the step measuring device characterized by the above-mentioned receiver equipping with communication devices, such as a GPS receiver and PHS, and an earth magnetism sensor in a step measuring device according to claim 1 to 5.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] Especially this invention relates to the approach and equipment which can detect walking distance and the walk direction correctly about a step measuring method and equipment.
[0002]
[Description of the Prior Art] Many problems about old-man care have occurred as the ratio of the elderly people who occupy to population increases in recent years. Among this, although many the approaches and equipment which take care of prevention or an old man promptly are proposed in wandering about a dementia old man's wandering problem, the wandering old-man survey instrument which transmits the positional information acquired by GPS especially with communication equipment, such as PHS, attracts attention.
[0003] Said wandering old-man survey instrument makes an old man carry the personal digital assistant constituted with communication equipment, such as a GPS circuit and PHS, if a Request to Send is advanced by the way, a current old man's location is transmitted from said personal digital assistant, it is the system which is the need from the base station arranged to domestic of being displayed on the map by the side of a base station, and examination is made by many companies and the local self-governing body.
[0004]
[Problem(s) to be Solved by the Invention] However, there are the following troubles in acquisition of the positional information by GPS.
(1) In the location whose empty, such as an arcade, an underground center, and a foot walk with many street trees, cannot be seen In order that the electric wave of a satellite may not reach, positional information cannot come to hand.
[0005] (2) In places which many buildings located, such as a city area, in order that the electric wave reflected in the building may interfere, exact positional information cannot be acquired.
[0006] (3) Since the error component is intentionally inserted in positional information, sufficient precision may not be acquired.
[0007] In order to compensate these troubles, it is necessary to attach a certain sensor in the body, to measure walking distance by this, and to amend positional information. Although the amendment by the so-called self-contained navigation using the acceleration sensor and oscillating gyroscope which were attached in the automobile is developed in the car-navigation system to which current spread is progressing, measurement by the acceleration sensor is proposed also in the walk of human being (JP,9-152355,A). Moreover, the method of finding walking distance is proposed by carrying out multiplication to the step which measured the number of steps at the time of a walk, using a sway sensor or a pressure-sensitive sensor as the other approaches, and was measured beforehand (the patent registration No. 2552135, others).
[0008] however, in measurement by the above-mentioned acceleration sensor Since the rate is slow as compared with an automobile, the change of acceleration of a walk of human being is a minute amount. Since detection is difficult, exact high measurement of precision difficult by measurement by the above-mentioned number of steps by the sway sensor and an above-mentioned step The conditions that a step is fixed and walks straightly beforehand were required, and since dispersion in a step and meandering took place by the old man with a doubtful walk as compared with ordinary adults, there was a trouble that an error was expanded as distance increased.
[0009] In this invention, it was made in order to cancel the above troubles, and it aims at offering the step measuring device which can measure the current position where precision is high, without

using the positional information by GPS.
[0010]
[Means for Solving the Problem] The ankle of right and left of the body is equipped with the step measuring device concerning claim 1 of this invention, and it receives the transmitter which transmits an acoustic wave, and the acoustic wave transmitted from the above-mentioned transmitter, and is equipped with the receiver which measures the phase contrast of the acoustic wave which carried out [above-mentioned] transmission, and the this received acoustic wave, and measures the distance between the above-mentioned transmitter and this receiver.
[0011] Claim 2 of this invention makes it possible to perform time-of-day doubling of the above-mentioned clock which was made to contain a clock in the above-mentioned transmitter and the above-mentioned receiver, respectively, connected this transmitter and this receiver to them mutually, and was built in both sides in the step measuring device of the claim 1 above-mentioned publication.
[0012] In the step measuring device of the claim 1 above-mentioned publication, as for claim 3 of this invention, the above-mentioned receiver distinguishes landing of a guide peg from change of the distance between the above-mentioned transmitter and this receiver.
[0013] In the step measuring device of the claim 1 above-mentioned publication, a guide peg steps forward and, as for claim 4 of this invention, the above-mentioned receiver distinguishes a direction from change of the distance between the above-mentioned transmitter and this receiver.
[0014] Claim 5 of this invention is set to the step measuring device of the claim 1 above-mentioned publication. The above-mentioned transmitter, And when one side is [the location of the transmitting section built in the above-mentioned transmitter in the attachment condition to the ankle of the above-mentioned receiver and the receive section built in the above-mentioned receiver] the front approach of an ankle and another side is the back approach of an ankle the above-mentioned receiver -- predetermined [of the distance between the above-mentioned transmitting section and the above-mentioned receive section] -- the number of steps -- it distinguishes with any the ankle of a left leg was equipped with any of the above-mentioned transmitter and this receiver, and the ankle of a right leg was equipped from the above change.
[0015] Claim 6 of this invention equips the above-mentioned receiver with communication devices, such as a GPS receiver and PHS, and an earth magnetism sensor in above-mentioned claim 1 thru/or a step measuring device given in either of 5.
[0016]
[Embodiment of the Invention] Hereafter, the step measuring device by the gestalt of operation of this invention is explained, referring to drawing.
[0017] Gestalt 1. drawing 1 of operation - drawing 4 are drawings for explaining the configuration of the step measuring device by the gestalt 1 of this operation, and drawing 5 - drawing 9 are drawings for explaining actuation of this step measuring device.
[0018] Drawing 1 is drawing showing the configuration of the transmitter of the step measuring device by the gestalt 1 of operation of this invention, and the attachment condition to a left leg. 11 is a transmitter with which the transmitting section 14 is included in the heel approach of an internal guide peg. The connection connector 12 for connecting this transmitter 11 and the receiver 31 in drawing 3 is formed in the side face by the side of the tiptoe of said transmitter 11. The piece of Velcro etc. is attached in 13 and the ankle of a left leg 15 can be equipped now with said transmitter 11 simple. Moreover, drawing 2 is the internal-block Fig. of said transmitter 11, and CPU21 and the clock 22 other than said transmitting section 14 are built into the interior of this transmitter 11.
[0019] Next, drawing 3 is drawing showing the configuration of the receiver of the step measuring device by the gestalt of operation of this invention, and the attachment condition to a right leg. Inside said receiver 31, the receive section 34 is included in the tiptoe approach of a guide peg. The connection connector 32 for connecting this receiver 31 and said transmitter 11 is formed in the side face by the side of the heel of said receiver 31. The piece of Velcro etc. is attached in 33 and the

ankle of a right leg 35 can be equipped now with said receiver 31 simple. Moreover, drawing 4 is the internal-block Fig. of said receiver 31, and CPU41, the clock 42, and the phase detecting element 43 other than said receive section 34 are included in the interior of this receiver 31.
[0020] Moreover, said transmitter 11 is carrying out firm output of the time of day of this transmitter 11 to said connection connector 12, and said receiver 31 will be equipped with the function to double the time of day of this receiver 31 at the time of day of this transmitter 11 automatically if the time of day of this transmitter 11 comes to be obtained by connection of said connection connector 12 and said connection connector 32.
[0021] Next, actuation is explained. Drawing 5 is drawing showing the relation of the acoustic wave transmitted from said transmitter 11 at the time of transmitting a 100Hz acoustic wave from said transmitter 11, and the acoustic wave received with said receiver 31. Said transmitter 11 transmits the 100Hz transmitted acoustic wave 51, and said receiver 31 calculates the relative distance of said transmitter 11 and this receiver 31 according to the delay 53 of a phase with said transmitted acoustic wave 51 of the received received acoustic wave 52. Moreover, 10ms of a 100Hz acoustic wave is one period, and said receiver 31 compares a phase with a transmitted acoustic wave at intervals of 10ms.
[0022] Next, drawing 6 is drawing showing the condition when equipping an ankle with said transmitter 11 and said receiver 31, and walking them. 61 shows a left leg, 62 shows a right leg here, respectively, and the distance between transmitter-receivers when 64 steps toward a left leg in the distance between transmitter-receivers when 63 steps toward a right leg is shown, respectively.
[0023] Drawing 7 is drawing which graph-ized change of the distance between said transmitter 11 in the condition of drawing 6 , and said receiver 31. When it steps toward a peak 71 with a left leg near at hand then, as a right leg steps toward DIP 72, it is a time of coming beside a left leg, and a peak 73 is a time of stepping forward with a right leg near at hand. Therefore, if the distance of said transmitter 11 and said receiver 31 is measured continuously, it can be considered that the distance of a peak period is a step.
[0024] Next, drawing 8 is drawing in the walk condition of equipping with the above-mentioned step measuring device, in which a guide peg's stepping toward and showing the amendment approach of change of walking distance for the travelling direction by change of a direction. 801,803,804,805 is the left leg which equipped the ankle with said transmitter 11, and 802 is the right leg which equipped the ankle with said receiver 31. In drawing, from said left leg 801 just before starting measurement, when it steps toward said first right leg 802 of the 1st step, it considers that the spacing 821 of said left leg 801 and said right leg 802 is the fixed value of 15cm, and a normal coordinate 831 is determined. This activity is only once done at the time of measurement initiation, and said normal coordinate 831 does not need to be required in order to express the migration location of both guide pegs on a coordinate to the last, and it does not need to be in agreement with a subsequent travelling direction. Therefore, any value is sufficient as the spacing 821 of said both guide pegs. Here, it is set as 15cm as spacing of both the usual average guide pegs. Next, a left leg 805 is in the condition which stepped toward an old travelling direction and the old same direction with the include angle to the left leg 803 at the time of stepping toward a guide peg delicately, and measures the distance 812 from said right leg 802 in the left leg 804 in the midpoint of the time amount which is moving from said left leg 801 to said left leg 805. A cosine theorem is applied to three parameters, this distance 812, the distance 813 of said left leg 805 and said right leg 802, and the distance 811 of said left leg 801 and said right leg 802, and the distance from said right leg 802 to said left leg 805 is computed to said normal coordinate 831 by decomposing into the parallel displacement distance 822 and the vertical migration distance 823.
[0025] Henceforth, whenever it steps toward a guide peg, by repeating the above-mentioned activity, it can step forward, a direction can be distinguished, a delicate change of the walking distance to a travelling direction can be amended, and accurate walking distance can be measured.
[0026] Next, drawing 9 is drawing which graph-ized change of the distance of said transmitter 11

and said receiver 31. Since said receive section 34 is attached in the back approach of a right leg neck for said transmitting section 14 by the front approach of a left leg neck with the gestalt 1 of this operation The relative distance 92 of both the guide pegs when stepping toward said transmitting section 14 and said receive section 34 with a left leg near at hand to the change 91 of the relative distance at the time of attaching in the core of an ankle at the time of a walk becomes long, and the relative distance 93 of both the guide pegs when stepping forward with a right leg near at hand becomes short. The difference of this relative distance is detected from walk data, and a guide peg on either side is distinguished. a delicate change of the walking distance which this showed by drawing 8 -- right and left -- it can recognize on which foot it has generated.

[0027] Thus, according to the gestalt 1 of this operation, a wearing person's walking distance and walk direction of a step measuring device can be acquired for the exact current position where precision is high measurement of a step, and by stepping forward and measuring correctly by distinction of a direction.

[0028] In addition, although the receiver with which the receive section was included in the left leg by the tiptoe approach of an internal guide peg in the transmitter with which the transmitting section was included in the heel approach of an internal guide peg was attached in the right leg with the gestalt 1 of the above-mentioned implementation, respectively This is good also as that by which the transmitter was attached in the right leg and it attached the receiver in the left leg, respectively, or good also as what included the transmitting section in the tiptoe approach of the guide peg inside a transmitter, and included the receive section in the heel approach of the guide peg inside a receiver.

[0029] Gestalt 2. drawing 10 of operation is drawing showing the wandering old-man survey instrument in the gestalt 2 of the operation of this invention which equipped the receiver of the step measuring device by the gestalt 1 of the above-mentioned implementation with GPS, PHS, and an earth magnetism sensor, and drawing 11 is the internal-block Fig. of the above-mentioned receiver.

[0030] In drawing 10 and drawing 11 , 105 is a receiver with which the GPS antenna 101, the GPS unit 113, and the earth magnetism sensor 103 are built into the interior, and is connected through the external cable 102 in external PHS104. Moreover, about the configuration of others of said receiver 105, it has a receive section 106, the connection connector 107, CPU111, the phase detecting element 112, and a clock 114 like the thing of the gestalt 1 of operation, respectively. In addition, about the configuration of a transmitter, it is the same as that of the thing of the gestalt 1 of operation.

[0031] The above-mentioned wandering old-man survey instrument is a system which said CPU111 receives the positional information which let said GPS unit 113 pass from said GPS antenna 101 with which said receiver 105 was equipped, and is automatically transmitted to a domestic base station with a fixed time interval from said PHS104 through said external cable 102. Or you may be the system which transmits positional information according to the call from the Family Bureau side.

[0032] Next, actuation is explained. First, if an old man goes out from a residence in the condition of having equipped with the above-mentioned wandering old-man survey instrument, the positional information by GPS will come to hand. Since the LAT LONG of a residence is a known value, it can cancel the error component of the positional information by early GPS by inputting on the basis of the location of a residence beforehand. Said step measuring device receives bearing from said earth magnetism sensor 103, distinguishes the walk direction and starts the migration length measurement by the step. In the condition that the positional information by GPS and the positional information by said step measuring device shift gradually, it judges that the positional information by said step measuring device is wrong, and amends by multiplying a step by the fixed numeric value. Step measuring accuracy is raised by performing this amendment at fixed spacing.

[0033] On the other hand, although the positional information by GPS is usually used, when the positional information by GPS differs from the positional information by said step measuring

device greatly, it judges that the error component of the positional information by GPS increased, and the positional information by said step measuring device is used. It is in the middle of going out, and puts in an arcade or a location with many street trees, and when it changes into the condition that the positional information by GPS is not acquired, the positional information by said step measuring device and the bearing information by said earth magnetism sensor 103 perform current position measurement.

[0034] Drawing 12 is drawing showing the condition of stopping and stopping in an arcade the old man who carried the above-mentioned wandering old-man survey instrument walking, and then having begun to return the original path. since a GPS signal is not acquired for the reason in an arcade -- the wave of step measurement -- an old man's action is measured by the bearing 122 which 121 and said earth magnetism sensor 103 show.

[0035] When the condition that the old man is walking in the north direction is now set to 123, the bearing 122 which said earth magnetism sensor shows points to north. and the wave of step measurement in the condition of 124 -- when 121 stopped changing, it is recognized that the old man stopped. Then, in the condition of 125, the bearing 122 which said earth magnetism sensor shows catches change of a direction, and it is recognized that the old man turned to the reverse direction. the condition of further 126 -- the wave of said step measurement -- 121 begins fluctuation and it is recognized that an old man began to walk again.

[0036] Moreover, if it inputs on the basis of the location of a residence beforehand even if it is a case so that the door of a residence may be in an arcade and the positional information by GPS may not be acquired from a depature point as further ill condition, the current position can be measured as migration length from there.

[0037] thus, in the wandering old-man survey instrument using GPS by the gestalt 2 of this operation In the effectiveness of the gestalt 1 of the above-mentioned implementation a wearing person's walking distance and walk direction of a step measuring device measurement of a step, and by stepping forward and measuring correctly by distinction of a direction In addition to the ability to have obtained the exact current position where precision is high, the exact current position can be obtained in a further more high precision by having used GPS.

[0038] In addition, it is [0039]. [good as that for which this used other means of communications although PHS was used for transmitting positional information with the gestalt 2 of this operation]

[Effect of the Invention] The transmitter with which the ankle of right and left of the body is equipped and which according to the step measuring device applied to claim 1 of this invention as mentioned above transmits an acoustic wave, Since it had the receiver which receives the acoustic wave transmitted from the above-mentioned transmitter, measures the phase contrast of the acoustic wave which carried out [above-mentioned] transmission, and the this received acoustic wave, and measures the distance between the above-mentioned transmitter and this receiver, it is effective in a step being calculable with the distance which carried out [above-mentioned] measurement.

[0040] Since it is possible to perform time-of-day doubling of the above-mentioned clock which the above-mentioned transmitter and the above-mentioned receiver contained the clock, respectively, connected this transmitter and this receiver mutually in the step measuring device of claim 1, and was built in both sides according to claim 2 of this invention, it is effective in the need of connecting both above-mentioned transmitter and above-mentioned receiver by a cable etc. at the time of measurement being lost.

[0041] According to claim 3 of this invention, in the step measuring device of claim 1, since landing of a guide peg is distinguished from change of the distance between the above-mentioned transmitter and this receiver, the above-mentioned receiver can recognize landing of a guide peg, without using a pressure-sensitive sensor, a foot switch, etc. to a flesh side of a guide peg, and is effective in the ability to perform exact step measurement.

[0042] According to claim 4 of this invention, in the step measuring device of claim 1, since a guide peg steps forward and a direction is distinguished from change of the distance between the above-

mentioned transmitter and this receiver, the above-mentioned receiver is effective in the ability to recognize change of the delicate travelling direction during a walk, without using a special sensor.
[0043] According to claim 5 of this invention, it sets to the step measuring device of claim 1. The above-mentioned transmitter, And the location of a receive section built in the transmitting section and the above-mentioned receiver in the attachment condition to the ankle of the above-mentioned receiver which were built in the above-mentioned transmitter One side is [another side] the back approach of an ankle in the front approach of an ankle. The above-mentioned receiver predetermined [of the distance between the above-mentioned transmitting section and this receive section] -- the number of steps, since it can distinguish with any the ankle of a left leg was equipped with any of the above-mentioned transmitter and the above-mentioned receiver, and the ankle of a right leg was equipped from the above change right and left -- it is effective in the ability to distinguish without using a special sensor in to which it is going to go.
[0044] According to claim 6 of this invention, since the above-mentioned receiver was equipped with communication devices, such as a GPS receiver and PHS, and an earth magnetism sensor in the step measuring device according to claim 1 to 5, even when it becomes impossible to receive a GPS signal in an arcade etc., it is effective in the current position being correctly detectable by performing current position amendment by the earth magnetism sensor and step measurement.

TECHNICAL FIELD

[Field of the Invention] Especially this invention relates to the approach and equipment which can detect walking distance and the walk direction correctly about a step measuring method and equipment.

PRIOR ART

[Description of the Prior Art] Many problems about old-man care have occurred as the ratio of the elderly people who occupy to population increases in recent years. Among this, although many the approaches and equipment which take care of prevention or an old man promptly are proposed in wandering about a dementia old man's wandering problem, the wandering old-man survey instrument which transmits the positional information acquired by GPS especially with communication equipment, such as PHS, attracts attention.
[0003] Said wandering old-man survey instrument makes an old man carry the personal digital assistant constituted with communication equipment, such as a GPS circuit and PHS, if a Request to Send is advanced by the way, a current old man's location is transmitted from said personal digital assistant, it is the system which is the need from the base station arranged to domestic of being displayed on the map by the side of a base station, and examination is made by many companies and the local self-governing body.

EFFECT OF THE INVENTION

[Effect of the Invention] The transmitter with which the ankle of right and left of the body is equipped and which according to the step measuring device applied to claim 1 of this invention as mentioned above transmits an acoustic wave, Since it had the receiver which receives the acoustic wave transmitted from the above-mentioned transmitter, measures the phase contrast of the acoustic wave which carried out [above-mentioned] transmission, and the this received acoustic wave, and

measures the distance between the above-mentioned transmitter and this receiver, it is effective in a step being calculable with the distance which carried out [above-mentioned] measurement.
[0040] Since it is possible to perform time-of-day doubling of the above-mentioned clock which the above-mentioned transmitter and the above-mentioned receiver contained the clock, respectively, connected this transmitter and this receiver mutually in the step measuring device of claim 1, and was built in both sides according to claim 2 of this invention, it is effective in the need of connecting both above-mentioned transmitter and above-mentioned receiver by a cable etc. at the time of measurement being lost.
[0041] According to claim 3 of this invention, in the step measuring device of claim 1, since landing of a guide peg is distinguished from change of the distance between the above-mentioned transmitter and this receiver, the above-mentioned receiver can recognize landing of a guide peg, without using a pressure-sensitive sensor, a foot switch, etc. to a flesh side of a guide peg, and is effective in the ability to perform exact step measurement.
[0042] According to claim 4 of this invention, in the step measuring device of claim 1, since a guide peg steps forward and a direction is distinguished from change of the distance between the above-mentioned transmitter and this receiver, the above-mentioned receiver is effective in the ability to recognize change of the delicate travelling direction during a walk, without using a special sensor.
[0043] According to claim 5 of this invention, in the step measuring device of claim 1, one side is the front approach of an ankle and another side of the location of a receive section built in the transmitting section and the above-mentioned receiver in the attachment condition to the ankle of the above-mentioned transmitter and the above-mentioned receiver which were built in the above-mentioned transmitter is the back approach of an ankle. the above-mentioned receiver -- predetermined [of the distance between the above-mentioned transmitting section and this receive section] -- the number of steps -- since it can distinguish with any the ankle of a left leg was equipped with any of the above-mentioned transmitter and the above-mentioned receiver, and the ankle of a right leg was equipped from the above change -- right and left -- it is effective in the ability to distinguish without using a special sensor in to which it is going to go.
[0044] According to claim 6 of this invention, since the above-mentioned receiver was equipped with communication devices, such as a GPS receiver and PHS, and an earth magnetism sensor in the step measuring device according to claim 1 to 5, even when it becomes impossible to receive a GPS signal in an arcade etc., it is effective in the current position being correctly detectable by performing current position amendment by the earth magnetism sensor and step measurement.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, there are the following troubles in acquisition of the positional information by GPS.
(1) In the location whose empty, such as an arcade, an underground center, and a foot walk with many street trees, cannot be seen In order that the electric wave of a satellite may not reach, positional information cannot come to hand.
[0005] (2) In places which many buildings located, such as a city area, in order that the electric wave reflected in the building may interfere, exact positional information cannot be acquired.
[0006] (3) Since the error component is intentionally inserted in positional information, sufficient precision may not be acquired.
[0007] In order to compensate these troubles, it is necessary to attach a certain sensor in the body, to measure walking distance by this, and to amend positional information. Although the amendment by the so-called self-contained navigation using the acceleration sensor and oscillating gyroscope which were attached in the automobile is developed in the car-navigation system to which current spread is progressing, measurement by the acceleration sensor is proposed also in the walk of

human being (JP,9-152355,A). Moreover, the method of finding walking distance is proposed by carrying out multiplication to the step which measured the number of steps at the time of a walk, using a sway sensor or a pressure-sensitive sensor as the other approaches, and was measured beforehand (the patent registration No. 2552135, others).

[0008] however, in measurement by the above-mentioned acceleration sensor Since the rate is slow as compared with an automobile, the change of acceleration of a walk of human being is a minute amount. Since detection is difficult, exact high measurement of precision difficult by measurement by the above-mentioned number of steps by the sway sensor and an above-mentioned step The conditions that a step is fixed and walks straightly beforehand were required, and since dispersion in a step and meandering took place by the old man with a doubtful walk as compared with ordinary adults, there was a trouble that an error was expanded as distance increased.

[0009] In this invention, it was made in order to cancel the above troubles, and it aims at offering the step measuring device which can measure the current position where precision is high, without using the positional information by GPS.

MEANS

[Means for Solving the Problem] The ankle of right and left of the body is equipped with the step measuring device concerning claim 1 of this invention, and it receives the transmitter which transmits an acoustic wave, and the acoustic wave transmitted from the above-mentioned transmitter, and is equipped with the receiver which measures the phase contrast of the acoustic wave which carried out [above-mentioned] transmission, and the this received acoustic wave, and measures the distance between the above-mentioned transmitter and this receiver.

[0011] Claim 2 of this invention makes it possible to perform time-of-day doubling of the above-mentioned clock which was made to contain a clock in the above-mentioned transmitter and the above-mentioned receiver, respectively, connected this transmitter and this receiver to them mutually, and was built in both sides in the step measuring device of the claim 1 above-mentioned publication.

[0012] In the step measuring device of the claim 1 above-mentioned publication, as for claim 3 of this invention, the above-mentioned receiver distinguishes landing of a guide peg from change of the distance between the above-mentioned transmitter and this receiver.

[0013] In the step measuring device of the claim 1 above-mentioned publication, a guide peg steps forward and, as for claim 4 of this invention, the above-mentioned receiver distinguishes a direction from change of the distance between the above-mentioned transmitter and this receiver.

[0014] Claim 5 of this invention is set to the step measuring device of the claim 1 above-mentioned publication. The above-mentioned transmitter, And when one side is [the location of the transmitting section built in the above-mentioned transmitter in the attachment condition to the ankle of the above-mentioned receiver and the receive section built in the above-mentioned receiver] the front approach of an ankle and another side is the back approach of an ankle the above-mentioned receiver -- predetermined [of the distance between the above-mentioned transmitting section and the above-mentioned receive section] -- the number of steps -- it distinguishes with any the ankle of a left leg was equipped with any of the above-mentioned transmitter and this receiver, and the ankle of a right leg was equipped from the above change.

[0015] Claim 6 of this invention equips the above-mentioned receiver with communication devices, such as a GPS receiver and PHS, and an earth magnetism sensor in above-mentioned claim 1 thru/or a step measuring device given in either of 5.

[0016]

[Embodiment of the Invention] Hereafter, the step measuring device by the gestalt of operation of this invention is explained, referring to drawing.

[0017] Gestalt 1. drawing 1 of operation - drawing 4 are drawings for explaining the configuration of the step measuring device by the gestalt 1 of this operation, and drawing 5 - drawing 9 are drawings for explaining actuation of this step measuring device.
[0018] Drawing 1 is drawing showing the configuration of the transmitter of the step measuring device by the gestalt 1 of operation of this invention, and the attachment condition to a left leg. 11 is a transmitter with which the transmitting section 14 is included in the heel approach of an internal guide peg. The connection connector 12 for connecting this transmitter 11 and the receiver 31 in drawing 3 is formed in the side face by the side of the tiptoe of said transmitter 11. The piece of Velcro etc. is attached in 13 and the ankle of a left leg 15 can be equipped now with said transmitter 11 simple. Moreover, drawing 2 is the internal-block Fig. of said transmitter 11, and CPU21 and the clock 22 other than said transmitting section 14 are built into the interior of this transmitter 11.
[0019] Next, drawing 3 is drawing showing the configuration of the receiver of the step measuring device by the gestalt of operation of this invention, and the attachment condition to a right leg. Inside said receiver 31, the receive section 34 is included in the tiptoe approach of a guide peg. The connection connector 32 for connecting this receiver 31 and said transmitter 11 is formed in the side face by the side of the heel of said receiver 31. The piece of Velcro etc. is attached in 33 and the ankle of a right leg 35 can be equipped now with said receiver 31 simple. Moreover, drawing 4 is the internal-block Fig. of said receiver 31, and CPU41, the clock 42, and the phase detecting element 43 other than said receive section 34 are included in the interior of this receiver 31.
[0020] Moreover, said transmitter 11 is carrying out firm output of the time of day of this transmitter 11 to said connection connector 12, and said receiver 31 will be equipped with the function to double the time of day of this receiver 31 at the time of day of this transmitter 11 automatically if the time of day of this transmitter 11 comes to be obtained by connection of said connection connector 12 and said connection connector 32.
[0021] Next, actuation is explained. Drawing 5 is drawing showing the relation of the acoustic wave transmitted from said transmitter 11 at the time of transmitting a 100Hz acoustic wave from said transmitter 11, and the acoustic wave received with said receiver 31. Said transmitter 11 transmits the 100Hz transmitted acoustic wave 51, and said receiver 31 calculates the relative distance of said transmitter 11 and this receiver 31 according to the delay 53 of a phase with said transmitted acoustic wave 51 of the received received acoustic wave 52. Moreover, 10ms of a 100Hz acoustic wave is one period, and said receiver 31 compares a phase with a transmitted acoustic wave at intervals of 10ms.
[0022] Next, drawing 6 is drawing showing the condition when equipping an ankle with said transmitter 11 and said receiver 31, and walking them. 61 shows a left leg, 62 shows a right leg here, respectively, and the distance between transmitter-receivers when 64 steps toward a left leg in the distance between transmitter-receivers when 63 steps toward a right leg is shown, respectively.
[0023] Drawing 7 is drawing which graph-ized change of the distance between said transmitter 11 in the condition of drawing 6 , and said receiver 31. When it steps toward a peak 71 with a left leg near at hand then, as a right leg steps toward DIP 72, it is a time of coming beside a left leg, and a peak 73 is a time of stepping forward with a right leg near at hand. Therefore, if the distance of said transmitter 11 and said receiver 31 is measured continuously, it can be considered that the distance of a peak period is a step.
[0024] Next, drawing 8 is drawing in the walk condition of equipping with the above-mentioned step measuring device, in which a guide peg's stepping toward and showing the amendment approach of change of walking distance for the travelling direction by change of a direction. 801,803,804,805 is the left leg which equipped the ankle with said transmitter 11, and 802 is the right leg which equipped the ankle with said receiver 31. In drawing, from said left leg 801 just before starting measurement, when it steps toward said first right leg 802 of the 1st step, it considers that the spacing 821 of said left leg 801 and said right leg 802 is the fixed value of 15cm, and a normal coordinate 831 is determined. This activity is only once done at the time of measurement

initiation, and said normal coordinate 831 does not need to be required in order to express the migration location of both guide pegs on a coordinate to the last, and it does not need to be in agreement with a subsequent travelling direction. Therefore, any value is sufficient as the spacing 821 of said both guide pegs. Here, it is set as 15cm as spacing of both the usual average guide pegs. Next, a left leg 805 is in the condition which stepped toward an old travelling direction and the old same direction with the include angle to the left leg 803 at the time of stepping toward a guide peg delicately, and measures the distance 812 from said right leg 802 in the left leg 804 in the midpoint of the time amount which is moving from said left leg 801 to said left leg 805. A cosine theorem is applied to three parameters, this distance 812, the distance 813 of said left leg 805 and said right leg 802, and the distance 811 of said left leg 801 and said right leg 802, and the distance from said right leg 802 to said left leg 805 is computed to said normal coordinate 831 by decomposing into the parallel displacement distance 822 and the vertical migration distance 823.

[0025] Henceforth, whenever it steps toward a guide peg, by repeating the above-mentioned activity, it can step forward, a direction can be distinguished, a delicate change of the walking distance to a travelling direction can be amended, and accurate walking distance can be measured.

[0026] Next, drawing 9 is drawing which graph-ized change of the distance of said transmitter 11 and said receiver 31. Since said receive section 34 is attached in the back approach of a right leg neck for said transmitting section 14 by the front approach of a left leg neck with the gestalt 1 of this operation The relative distance 92 of both the guide pegs when stepping toward said transmitting section 14 and said receive section 34 with a left leg near at hand to the change 91 of the relative distance at the time of attaching in the core of an ankle at the time of a walk becomes long, and the relative distance 93 of both the guide pegs when stepping forward with a right leg near at hand becomes short. The difference of this relative distance is detected from walk data, and a guide peg on either side is distinguished. a delicate change of the walking distance which this showed by drawing 8 -- right and left -- it can recognize on which foot it has generated.

[0027] Thus, according to the gestalt 1 of this operation, a wearing person's walking distance and walk direction of a step measuring device can be acquired for the exact current position where precision is high measurement of a step, and by stepping forward and measuring correctly by distinction of a direction.

[0028] In addition, although the receiver with which the receive section was included in the left leg by the tiptoe approach of an internal guide peg in the transmitter with which the transmitting section was included in the heel approach of an internal guide peg was attached in the right leg with the gestalt 1 of the above-mentioned implementation, respectively This is good also as that by which the transmitter was attached in the right leg and it attached the receiver in the left leg, respectively, or good also as what included the transmitting section in the tiptoe approach of the guide peg inside a transmitter, and included the receive section in the heel approach of the guide peg inside a receiver.

[0029] Gestalt 2. drawing 10 of operation is drawing showing the wandering old-man survey instrument in the gestalt 2 of the operation of this invention which equipped the receiver of the step measuring device by the gestalt 1 of the above-mentioned implementation with GPS, PHS, and an earth magnetism sensor, and drawing 11 is the internal-block Fig. of the above-mentioned receiver.

[0030] In drawing 10 and drawing 11 , 105 is a receiver with which the GPS antenna 101, the GPS unit 113, and the earth magnetism sensor 103 are built into the interior, and is connected through the external cable 102 in external PHS104. Moreover, about the configuration of others of said receiver 105, it has a receive section 106, the connection connector 107, CPU111, the phase detecting element 112, and a clock 114 like the thing of the gestalt 1 of operation, respectively. In addition, about the configuration of a transmitter, it is the same as that of the thing of the gestalt 1 of operation.

[0031] The above-mentioned wandering old-man survey instrument is a system which said CPU111 receives the positional information which let said GPS unit 113 pass from said GPS antenna 101

with which said receiver 105 was equipped, and is automatically transmitted to a domestic base station with a fixed time interval from said PHS104 through said external cable 102. Or you may be the system which transmits positional information according to the call from the Family Bureau side.

[0032] Next, actuation is explained. First, if an old man goes out from a residence in the condition of having equipped with the above-mentioned wandering old-man survey instrument, the positional information by GPS will come to hand. Since the LAT LONG of a residence is a known value, it can cancel the error component of the positional information by early GPS by inputting on the basis of the location of a residence beforehand. Said step measuring device receives bearing from said earth magnetism sensor 103, distinguishes the walk direction and starts the migration length measurement by the step. In the condition that the positional information by GPS and the positional information by said step measuring device shift gradually, it judges that the positional information by said step measuring device is wrong, and amends by multiplying a step by the fixed numeric value. Step measuring accuracy is raised by performing this amendment at fixed spacing.

[0033] On the other hand, although the positional information by GPS is usually used, when the positional information by GPS differs from the positional information by said step measuring device greatly, it judges that the error component of the positional information by GPS increased, and the positional information by said step measuring device is used. It is in the middle of going out, and puts in an arcade or a location with many street trees, and when it changes into the condition that the positional information by GPS is not acquired, the positional information by said step measuring device and the bearing information by said earth magnetism sensor 103 perform current position measurement.

[0034] Drawing 12 is drawing showing the condition of stopping and stopping in an arcade the old man who carried the above-mentioned wandering old-man survey instrument walking, and then having begun to return the original path. since a GPS signal is not acquired for the reason in an arcade -- the wave of step measurement -- an old man's action is measured by the bearing 122 which 121 and said earth magnetism sensor 103 show.

[0035] When the condition that the old man is walking in the north direction is now set to 123, the bearing 122 which said earth magnetism sensor shows points to north. and the wave of step measurement in the condition of 124 -- when 121 stopped changing, it is recognized that the old man stopped. Then, in the condition of 125, the bearing 122 which said earth magnetism sensor shows catches change of a direction, and it is recognized that the old man turned to the reverse direction. the condition of further 126 -- the wave of said step measurement -- 121 begins fluctuation and it is recognized that an old man began to walk again.

[0036] Moreover, if it inputs on the basis of the location of a residence beforehand even if it is a case so that the door of a residence may be in an arcade and the positional information by GPS may not be acquired from a depature point as further ill condition, the current position can be measured as migration length from there.

[0037] thus, in the wandering old-man survey instrument using GPS by the gestalt 2 of this operation In the effectiveness of the gestalt 1 of the above-mentioned implementation a wearing person's walking distance and walk direction of a step measuring device measurement of a step, and by stepping forward and measuring correctly by distinction of a direction In addition to the ability to have obtained the exact current position where precision is high, the exact current position can be obtained in a further more high precision by having used GPS.

[0038] In addition, although PHS was used for transmitting positional information with the gestalt 2 of this operation, this is good also as what used other means of communications.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the appearance Fig. of the transmitter of the step measuring device in the gestalt 1 of operation of this invention.

[Drawing 2] It is the internal-block Fig. showing the configuration of the transmitter of the above-mentioned step measuring device.

[Drawing 3] It is the appearance Fig. of the receiver of the above-mentioned step measuring device.

[Drawing 4] It is the internal-block Fig. showing the configuration of the receiver of the above-mentioned step measuring device.

[Drawing 5] It is the phase-comparison Fig. of the transceiver acoustic wave of the above-mentioned step measuring device.

[Drawing 6] It is drawing showing the walk condition of equipping with the above-mentioned step measuring device.

[Drawing 7] It is drawing showing the relative distance between the transmitter-receivers in the walk condition of equipping with the above-mentioned step measuring device.

[Drawing 8] It is drawing in the walk condition of equipping with the above-mentioned step measuring device, in which a guide peg's stepping toward and showing the amendment approach of change of walking distance for the travelling direction by change of a direction.

[Drawing 9] It is drawing showing the distinction approach of the guide peg the right and left in the walk condition of equipping with the above-mentioned step measuring device.

[Drawing 10] It is drawing showing the wandering old-man survey instrument equipped with the above-mentioned step measuring device in the gestalt 2 of operation of this invention.

[Drawing 11] It is the internal-block Fig. showing the configuration of the receiver of the wandering old-man survey instrument equipped with the above-mentioned step measuring device.

[Drawing 12] It is drawing showing the condition of stopping and stopping in an arcade the old man who carried the wandering old-man survey instrument walking, and then having begun to return the original path.

[Description of Notations]

11 Transmitter
12 32,107 Connection connector
13 33 Piece of Velcro etc.
14 Transmitting Section
15 Left Leg
21,41,111 CPU
22 42,114 Clock
31 Receiver
34,106 Receive section
35 Right Leg
43,112 Phase detecting element
61 Left Leg
62 Right Leg
63 Distance between Transceiver Sections when Stepping toward Right Leg
64 Distance between Transceiver Sections when Stepping toward Left Leg
101 GPS Antenna
102 External Cable
103 Earth Magnetism Sensor
104 PHS
105 Receiver 113 GPS Unit